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ABSTRACT

Systems theory and its application to educational administration are discussed in this paper. An extensive literature review concludes that systems analyses are based on the concept of interdependence and on the assumption that the whole may be greater than the sum of its parts. Applications to educational administration include model building, hypothesis testing, practical everyday decision making, effective evaluation, and improved communication. The view of educational administration as a social process within a social system and schools as open social systems facilitates the development of a framework to understand organizational roles and relationships. The conclusion is that thinking in a systems mode is an effective method for everyday, practical administrative decision making. (15 references) (LMI)

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GENERAL SYSTEMS THEORY: IMPLICATIONS FOR EDUCATIONAL ORGANIZATIONS AND ADMINISTRATION

SUBMITTED TO
PROFESSOR TAHER A. RAZIK, PH.D.

MAY 1, 1990

SUBMITTED
BY

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The development of systems thinking was a reaction to the scientific theories and viewpoints of the 1920s and 1930s. This fragmentation created field-related isolationistic tendencies that severely limited cross-discipline contributions (Emery, 1971).

The introduction of "The Systems View" in Management Systems: Conceptual Considerations by Schoderbek, Schoderbek and Kefalas (1990) begins with a quote from Blaise Pascal, "I find as impossible to know the parts without knowing the whole, as to know the whole without specifically knowing the parts." This sentiment accurately reflects the tenets of systems thinking. The authors state that this mode of thinking is indispensable to solving present day management problems. Examples of the automobile industry and farming are given to show how analysis of problems depends upon a systems approach to be most effective.

This contrasts with the analytical approach where a whole is broken down into parts and then studied. Although this method existed for years and typified the scientific community, biologists were the first to seek alternative approaches to analysis. The rise of complex organizations also contributed to the popularity of the systems approach. Systems thinking does not replace the analytic approach but supplements it. Rather than microanalyzing the parts, the systems theorist can focus on the processes that link the parts together. Some

theorists make a distinction between systems philosophy, systems methodology, and systems techniques.

Churchman (1968) has delineated five basic considerations on systems thinking: 1) objectives with performance measures, 2) environment, 3) resources, 4) components of the system, and 5) the management of the system. This is not meant to be all inclusive but does represent commonalities from many researchers. Objectives of the system need to be operationalized to be most effective and clear. The resource aspect also includes the organizational people, which many management scholars, like Peter Drucker, feel is the most important resource. The components aspect (what people should be doing, not what they are doing) includes all organizational missions, activities, and jobs that must be done toward the realization of objectives. Management includes the planning and controlling aspects of an organization, also the feedback and cybernetic-type processes.

For the basis of further discussion, the authors rely on the definition of a system as: "a set of objects together with the relationships between the objects and their attributes related to each other and their environment so as to form a whole.", (Hall and Fagen, 1968). The observer is an integral part of the system itself and this is not directly reflected in the previous definition. The objects of a system are the specific inputs, processes, and outputs. Input may be energy,

information, humans, or matter. Feedback is also classified as an input as it is rerouted into the system.

The transformation process that takes place as inputs become outputs, is somewhat complex and differs in detail from organization to organization. Various combinations of inputs may create different outputs even in the same organization. In some organizations this may take a form similar to that of an assembly line. Some organizations are so complex that this process is difficult to describe due to the vast number of interrelationships.

Outputs may take the form of products, services, or energy. These are the very purpose for the organization's existence. The output of one system often becomes the input for another system. Outputs can be classified into three groups: 1) inputs for other systems, 2) things consumed within the organization for the next input-output cycle, and 3) waste that is neither consumed by other systems or within the system itself, but that enters the ecological system as input.

Synergistic relationships help to hold the subsystems together. These are combined efforts that add substantially to the system's performance. Relationships can also be symbiotic, where a subsystem cannot function alone but depends upon other subsystems for its existence. This symbiosis may be unipolar or bipolar and often easily identifiable. A third type of relationship is that of the redundant relationship. These are duplicates of other relationships, but the redundancy increases

the probability that an organization will function as it was intended. Redundant, or backup, relationships, help to secure operational systems and subsystems.

A system's environment is considered by the authors, to be external to the system. Some scholars suggest internal aspects as well but Schoderbek, Schoderbek, and Kefalas state that this is then belonging to and part of the system and not to be considered as "environment". Environment may be external to the system's control but it can be responsive to the system's behavior. Environments may be stable or they may be dynamic at any given time. Churchman (1979) suggests defining the relevance and the control aspects of a factor to determine in it is environmental, systemic, or neither. The degree of this controllability directly reflects the organization's ability to use these resources toward its goal. This ability is a function of the three factors of existence of resources, managerial talent, and organizational intelligence. All these aspects affect the ability to devise appropriate strategies to deal with environmental factors. Organizations best function as open systems, the separation between them and their environment must be flexible enough to provide for feedback and changes significant enough to promote survival and growth.

In treating the system as a whole, recognizing that it may be greater than the sum of its parts, it may also be helpful to create a schematic representation. Demarcation lines and environmental and subsystem boundaries will then need to be

defined. Control functions, feedback loops, and other relationships should be present if an open system is depicted. Boundaries will show the relationships and interactions, or lack of interactions, around variables. Although these boundaries may be arbitrary, the one who has determined the system's goals may be in the best position to also set focal points and boundaries. Boundaries can be too broad and eliminate any solution, or they can be too narrow and prevent any meaningful solution from emerging. Systems goals may change if the boundaries are changed, some consistency must be maintained here if correct representation is to occur and be of analytic value. The most critical value of this model building is to include all pertinent and intervening variables.

The major reason for adopting a systems view is that it facilitates the development of an overall framework to better understand organizations. Major forces, variables, in both the internal aspects organization and the external environment can be better considered using a systems approach.

Hodge and Anthony's (1988) definition of a system is as follows: it is an organized or complex whole that is an assemblage or combination of things or parts as a unitary whole (Kast and Rosenzweig, 1970). This implies interdependency, holism, and synergism. Synergism is the interactive effect of the parts of a system working together, basically the concept of the whole is greater than the sum of its parts.

Subsystems are a direct reflection of the holism concept. The determination of a subsystem depends upon the level of abstraction at any one point of analysis. Open and closed system characteristics must be considered when analyzing subsystems. It is important to view this concept of open or closedness as a continuum rather than a dichotomy. Any subsystem or system may be in any degree of open or closedness at any one time and just because they are in that state at present does not mean they will remain so. The railroad industry was used as an example of an open system that became closed and eventually open again, as input from their environment was effectively used as feedback.

Functionalism attempts to look at systems in terms of structures, processes, and functions. In functionalism, there is an active attempt to explain rather than merely describe the functioning of a particular system. Just as in the open-closed concept, there is a continuum of an organization either being functional or dysfunctional. Within this functionality, a system may be anywhere along the continuum of being static or dynamic. This characteristic may differ depending upon which level of analysis is being studied. An organization may be static in one element and dynamic in another, at the same time.

There can also be both abstract and concrete systems. Abstract systems consist of ideas and concepts. Concrete systems are composed of physical and material resources. An organization may truly be composed of both types of systems and

it is important that each is treated accordingly. Systems can be classified behaviorally according to their function as: 1) state maintaining, 2) goal seeking, 3) multi-goal seeking, and 4) purposeful. In each of these four elements the communication and control system that maintains a steady state is a cybernetic systems. They rely on outside devices that help magnify forces for self-correction. These cybernetics act as stabilizing mechanisms, towards maintaining some homeostatic condition.

An input-output analysis involves the examination of the flow of materials, ideas, concepts, money, and people through the system. This analysis must consider inputs, a transformation process, outputs, and a feedback process. Feedback serves to recycle the inputs so that the transformational process can adapt and help to maintain the organizational health of the system.

Organizations transform inputs into outputs through interactions with their outside environment. They are affected by it and in turn attempt to affect it. This is a constant source of opportunities and constraints. Inputs must consist of the four essential resources: 1) human, 2) physical, 3) financial, and 4) informational. In many social based organizations, such as schools, the greatest resource is the human aspect. The proper mix of skills, knowledge, aspiration, and ability are often key to an organization and not purchasable.

Transformation involves adding value to inputs as well as the structuring of an organization, their policies, procedures, and rules. The behavioral climate and decision-making processes are also elements in this transformational phase. The results are the organization's outputs, consisting of products and services as well as the very productivity and efficiency of the organization itself.

The systems approach's major advantage is the viewing of the organization as a whole. Organizational interface with the environment is also a key consideration. This allows for model building depicting the flow of interrelationships between elements. Hypothesis generation and empirical research are therefore easily encouraged by this model building ability. Quantification can be developed through this systems approach as well, leading to future possibilities.

One must be careful not to misunderstand or misuse the systems approach. It can lead to an oversimplification of organizational relationships. This relies heavily on analytical and conceptual models that may not always lend themselves to express all the relationships among individual elements. Often it is difficult to trace the cause-effect relationships within an open system, as opposed to those of a closed system, which causes criticism of the systems approach in general. The idea of "bounded rationality", Simon (1957), can help to account for this uncertainty. Many also find the systems approach to abstract and difficult to apply. However,

it is a valuable analytic tool when the model building and quantitative aspects are carefully considered to be only one aspect of the application. The descriptive ability and the understanding of the complexities of human relationships are true benefits from a systems view/approach.

General systems theorists also believe in some ten common properties: 1) the interrelationship of objects and their attributes, 2) holism, 3) goal seeking, 4) inputs and outputs, 5) a transformation process, 6) entropy, 7) regulation (dealing with management and cybernetics),
8) hierarchy, 9) differentiation (specialization), and 10) equifinality.

Boulding (1956) suggests a system of systems increasing in complexity from level one through level nine. Level 1 is termed "Frameworks" and represents the static description of relationships within a system. Level 2: Clockworks, includes simple dynamic systems that tend toward equilibrium. Cybernetics: level 3, consists of a specific level of equilibrium maintenance. Level 4: Open System, is concerned with self-maintenance and self-reproduction. Level 5: Genetic-Societal, is typified by a division of labor. Level 6: Animal Level, involves mobility, goal seeking, and self-awareness. Level 7: Human Level, while including all the traits of the Animal Level, also includes the concept of self-consciousness. Level 8: Social Organization, includes the effect of history and society in shaping roles. Level 9:

Transcendental, represents the systems for which we have no answers and are often so complex they are indescribable. Many changes have occurred since Boulding's description of this hierarchy which may affect his somewhat pessimistic view of the gap between theoretical models and empirical knowledge.

This classification system may help us to be aware of the level of theoretical analysis that we are using when looking at the empirical world under investigation. It is important that this be at the same level and not below. Although one can argue Boulding's perception of developments, in relation to recent social/science events, or the ordering of his levels of complexity, his hierarchy is logical and consistent.

The distinction between open and closed systems is the concept most mentioned in systems theory. The difference between these basically deals with resource availability. In a closed system all resources are contained within. An open system interacts with its environment for resource allocation. Scholars have stated that the concept of a closed system may only exist in the mind, since environment is so universal. It is important during analysis, to be aware of the fallacy of reification, the treating of an open system as if it were closed.

Isomorphic systems account for the similarities between systems in structure and in abstraction. These similarities and apparent correspondences have allowed for prediction from one situation to another. The entire branch of control studied

through cybernetics is based on the premise of isomorphic relationships. It is important to note the distinction between analogies and isomorphisms. Analogies are a great tool for the systems theorist and have led to may new discoveries and relationships. All isomporhisms are analogies but not all analogies are isomorphisms. Isomorphisms are only concerned with a likeness of structure, which is a very specific form of analogy. An isomorphic relationship occurs when there is a one-to-one correspondence between elements of one system to another, as

proposed through the research of Klir and Valachi (1967).

Systems theorists believe there is a hierarchy in systems as well as a system of systems. In the realm of systems design and the contriving of a system, the system within a system concept must be carefully planned and implemented if all is to function as a system/whole. Simon (1970) describes a system as a hierarchic group of interrelated subsystems. Some subsystems have more interactions within themselves than with other subsystems or the system as a whole, Simon terms these as "decomposable". Decomposable systems have the short-run behavior characteristics of being independent. Systems that are nondecomposable are dependent upon other systems and directly influence other systems or subsystems as well. This hierarchic view does allow for some simplification in understanding of the subsystem relationships and structure.

Adaptability is often used to classify organizations and systems. This can take place in the short term or the long term. Most of the short term change takes place either internally or externally relating to some system or subsystem function. The long term adaptation tends to center around structural change either within the system (Darwinian) or within the system's environment (Singerian).

An obvious prerequisite to adaptation is the familiarity with the environment, with both some degree of willingness and ability to change. Information acquisition and response to feedback are key elements of an organization's ability and willingness to adapt.

One of the critical differences between social systems and natural systems is the ability to help the evolutionary process along by seeking appropriate and timely mechanisms to formulate effective adaptation. Contingency views have been developed by studying various organizations and their systemic healthiness. Structures may take different forms for different organizations and even different forms throughout the different stages of an organization's evolutionary process.

Greiner (1972) has proposed a model that typifies organizational change as five different phases that run through the two stages called evolutionary and revolutionary. Each evolutionary phase causes its own revolution, periods of substantial turmoil. Each phase possesses a dominant managerial style that is optimal at affecting both the rate and

direction of growth. At each of these phases, specific managerial problems must be overcome to proceed ahead to another phase. Phase 1 consists of evolutionary creativity followed by leadership crisis. An example would be organizations based or formed by the technical competence of someone but lacking managerial skills to constitute good business or organization functioning. Phase 2 is a period of directed evolutionary growth followed by an autonomy crisis. This is exemplified by a hierarchical organization that lacks communication, where employees become frustrated, alienated, and morale declines. Phase 3 has growth through delegation followed by a control crisis. Subsystems appear to be too independent, this is usually followed by centralization which causes other problems. Phase 4 consists of growth through coordination followed by a crisis in bureaucracy. This is often characterized by a rigid, inflexible organization insisting on adherence to rules first. Phase 5 is characterized by collaboration followed by a crisis of unknown origin. Greiner suggests five organizational dimensions that are essential for the historical understanding of this growth process of any organization: 1) age of the organization, 2) size, 3) stage of evolution, 4) stage of revolution, and 5) the growth rate of the industry in general. A knowledge of these phases should help a manager better understand the organization's past history.

Some of the benefits of a systems approach include freeing the manager from a narrow functional viewpoint, permitting goals to be viewed as relating to the organization as a whole, allows the organization to structure subsystems in a manner that is consistent with system goals, and it provides evaluation techniques for assessing the effectiveness of subsystems. Problems can be viewed from various levels of resolution and approached effectively using specific methods.

General systems theory provides the basis for the integration of scientific knowledge across a broad spectrum. A hierarchy of nine systems has been proposed. The first of which is the static structure or frameworks type of system. The second type is the dynamic system which deals with some type of motion. The control or cybernetic system, which is self-regulatory, is the third type in the hierarchy. The open system is fourth and is self-maintaining. Fifth is the genetic/societal system. The animal system is sixth dealing with teleological behaviors. The human level is next involving language and symbolism. Eighth is the social system and ninth are the transcendental systems.

The first three levels are physical and mechanical, the next three are biologically based systems, and the last three are all involved with the social sciences especially the arts, humanities, and religion. This provides the basis for the understanding and integration of knowledge from a wide variety of specialized fields.

Bertalanffy made distinctions between open systems and closed systems. This application has been particularly relevant to the social sciences especially to the development of functionalism. Functionalism exists in many disciplines and refers to the relationship and integration of parts and subsystems into a function whole. Talcott and Parsons led the adoption of this perspective in sociology. This has also achieved particular success in the field of psychology. The Gestalt school of psychology is based on functionalism and the very word in German means pattern. Kurt Lewin took this approach and applied it to individual personality studies.

Modern economics also uses a systems approach in its studies of the field. The very idea of equilibrium encompasses the systems view. Analysis of subsystems and their relationship to a total system represents the key methodology. The foundation of the discipline of cybernetics is based upon a systems approach, applying to both biological and social systems. The systems approach emphasizes that holism is the process, not separately examining the components and then putting them together into a system. The whole may be greater than the sum of its parts. The systems view has become the major operating framework of many physical and social sciences (Chin, 1961).

Traditional organization theory used a closed system approach. Modern theory has replaced that view with one of an open system approach. Barnard (1938) and Simon (1964) were two

earlier management writers that used a systems approach. This was the term the used to refer to scientific analysis of these complex organizational systems. Homans (1950) also used systems concepts as the basis for empirical research on social groups. The three elements of a social system that Homans proposed are also present in organizations: activities, interactions, and sentiments.

The systems approach has also been used in studies other than in the United States. The Tavistock Institute in England (1960) has used this theory to examine human relations and organizational interaction within its environment throughout various industrial studies. Katz and Kahn (1966) have used such theories as the basis for psycho-social studies of organizations. They state that the psychological approach does not adequately deal with the facts of structure within organizations, and they use systems theory to create an integrated model.

The systems approach has been used as the basis of the defense and space programs of the United States as well. Program management is geared to changing managerial requirements for optimal resource utilization. Other governmental projects such as urban renewal, transportation, and pollution control also rely on a systems approach. This modern view treats the organization as a system of mutually dependent components and variables, which is part of the whole system of society.

Systems have the two main characteristics of either being open or closed in relationship to their environment. Traditionally, organizations were thought to be independent enough that they could be analyzed as a closed system. Closed systems tend to move toward entropy, a term from thermodynamics that refers to movement toward a chaotic state in which no energy transformation takes place. Biological and social systems relate to an open systems viewpoint. Open systems adapt to their environment by changing their structure and internal processes. The goal is to reach a steady state of dynamic equilibrium at which optimal functioning can occur. Open-system views provide the basis for the development of a more comprehensive theory of organizations.

Organizations are also viewed as structured sociotechnical systems. This thinking came from the Tavistock studies of Trist (1960) and others. Both a technological organization and a work organization are necessary for production to occur. Human activities are structured and integrated around various technologies. The social system then defines the effectiveness and efficiency of the utilization of these technologies, shaped by the knowledge and skills required. The structure of the organization may be considered another subsystem integrating with the social and technical subsystems. Specific inputs may determine specific responses that include organizational restructuring. The modern view looks at organizations as

structured, social, technical systems that have several primary subsystems that interact with each other.

Systems have several other characteristics. Social systems are basically contrived systems, exact analogies between these systems and physical and biological systems are, as a result, sometimes difficult. Boundaries exist in all systems that delineate definitions of system and subsystem activities. There are many transactional interfaces between systems across boundaries involving the transfer of energy, materials, people, money, resources, and information.

All systems are also part of a hierarchy. This hierarchy is not just structural but is also a hierarchy of processes as well, often both internal and external. Entropy is also a characteristic of all systems. This is countered by the continued importing of energy and inputs, transforming them and redistributing the resources in the form of outputs. If this continued flow exists a state of dynamic equilibrium (homeostasis) can occur which is the true goal of an open, and healthy, system.

This homeostasis can only be accomplished through feedback mechanisms. Negative and positive feedback is constantly analyzed and interpreted with organizational corrections made to accomplish a balance. Both adaptive and maintenance structures must exist and respond to this feedback. Internal elaboration is one method of growth. Greater differentiation and specialization within subsystems is an example of this

adaptive elaboration function. Systems also share the characteristic of equifinality. This is the ability to reach goals in many different ways. This negates the "one-best way" view and allows for optimal adaptability and maintenance of effort toward reaching goals.

Parsons (1960) proposed three managerial levels or structures in the managerial system: 1) the technical/production level, 2) the organizational/managerial level, and 3) the institutional/community level. The technical level involves task performance; research and development, production control, marketing research, etc. The organizational level coordinates the task performance, integrating materials, energy, and information. The institutional level relates the activities of the organization to the environmental system.

The managerial systems spans the entire organization and directs technology, organizes people and resources, and communicates with and relates to the environment. This must have an open systems view and contain adaptive and maintenance structures to insure survival and growth. The managerial system involves technical core activities, intraorganizational interactions, and inter-institutional relationships. These roles may be separated theoretically but in practice other linkages can occur. There is overlap and different types of integrations may occur, departing from the traditional scalar concept of chain of command.

The role of the manager in an open system is decidedly different from the rational-economic approach of a closed system. The main focus must be a coalignment, a reduction of uncertainty as well as a maintenance of flexibility. Petit (1967) suggests classifying managers as to their duties: technical, organizational, or institutional. The frames of reference are quite different for each of these roles. Sayles (1964) emphasizes that a manage must deal with ambiguity and constantly seek a moving equilibrium with effective decision-making as their prime responsibility.

This modern view creates new roles for managers. They must integrate and balance various subsystems and their activities within larger environmental settings and larger suprasystems.

Most of the time we take a non-systems approach to organizational problem solving. We search for one specific cause/effect relationship. The organization can be separated into subsystems and these subsystems can be analyzed separately while keeping the entire system in mind, therefore reflecting the true systems approach. Change in one subsystem often effects another. An understanding of the content of a system is key to understanding the interplay between forces within an organization.

Several definitions have been presented. However they all have the common element of interdependence of variables and the fact that the whole (the system) may be greater than the sum of

its component parts. Boulding (1956) has proposed a hierarchy of nine levels of systems. Within this hierarchy, he cautions that the building of good theoretical models is still a somewhat future capability. Although we must think in terms of systems our ability to use systems theory is still limited. One of the more promising efforts has been made in the field of cybernetics systems. We must acknowledge, however, that we still have a great deal of deficiency in our understanding of the systems theory in social based organizations dealing with human behavior.

Katz and Kahn (1966) have developed one of the most complete descriptions of the application of systems theory to social organizations. They list nine characteristics of an open system. These nine characteristics are: 1) importation of energy, 2) throughput (transforming of energy into a product, process, or service), 3) output, 4) cycles of events, 5) negative entropy, 6) information input, negative feedback, and the coding process, 7) dynamic homeostasis, 8) differentiation, and 9) equifinality. Katz and Kahn warn against the difference between these characteristics and the use of a physical model to apply systems theory. Using a physical model causes one to lose sight of the loose coupling of variables within a social organization/system. System maintenance tends to be ignored with this approach.

Huse and Bowditch (1973) define the characteristics slightly differently than Katz and Kahn. They believe that

social systems consist of many highly interdependent and interrelated subsystems. Also that a social system uses both positive and negative feedback to achieve balance and that there is a multiplicity of goals and objectives that may, at times, be in conflict with each other.

The most important element of using a systems approach to social systems is the fact that a change in one subsystem will have an impact on all other subsystems. An example is presented to illustrate this characteristic. A toy company changed a particular division's bonus schedule based on their controlling the speed on the assembly line for painting. Other workers in the organization complained and unilateral decisions were made to reinstitute the old methods. The personnel involved and affected by the original change soon quit due to job dissatisfaction. The change in this one subsystem affected many others in the company and although they went back to the original ways, the workers that were part of that initial change then quit.

The concept of role is key to a systems approach. Role is the personal psychological link to the organization. This is combined with the expectations of others within the system. This forms an overlap of internal and external forces. Role conflict, role ambiguity, and organizational stress can occur from these relationships. Any of these problems can affect personal dissatisfaction and ultimately the organization as a whole. A belief in this approach and definition of role

clearly help to eliminate the single-cause approach to problem solving.

Seiler (1967) points out that systems tend toward equilibrium. This does not imply optimal balance. If a system cannot change, there is little progress. As subsystems change the actual equilibrium is also changing and what was a balance before may not be a balance in the future. This concept of balance/equilibrium is constantly in motion and cannot be viewed from a single cause perspective.

The concept of function is important to understanding the analysis of a system. The interdependence of subsystems is neither good nor bad but is developed through definitions of function. The function of a particular subsystem may be effective for that subsystem but could actually be dysfunctional to the organization as a whole. A unilateral decision could therefore destroy the system as a whole or have a significant negative impact on the subsystem, again therefore affecting the system as a whole. An example was used of a credit manager wanting to cut credit losses but going too far and cutting the ability of customers to use their services, therefore significantly cutting the organization's income.

A careful study of boundaries is needed to fully understand the analysis of a system. Boundaries are different if one is analyzing attitudes, norms, and behaviors of a particular work group or if one is examining the information flow through a system. Boundaries vary within social systems

but are necessary to define to separate variables if conducting an analysis. The multiplicity of purposes and functions are further defined and delineated within these boundaries. Levels of complexity and the relationships of subsystems to systems to suprasystems are necessary to effectively evaluate an organization. "System lenses", a concept presented by Duncan (1974), can be used to provide the necessary multiple viewpoints needed during a systems analysis.

Seiler describes a system as consisting of four basic areas: 1) human inputs, 2) technological inputs, 3) organizational inputs, and social structure and norms. He suggests a tremendous amount of interaction, influence, and interdependency within these areas. However, Huse and Bowditch see the need for the three perspectives of: 1) structural-design perspective, 2) work-flow perspective, and 3) the human perspective. They suggest a simultaneous attention to all three elements as being the only way to effectively deal with the complexities of social organizational systems. Although these theorists differ, they still share the interdependency characterized by the systems approach.

The interdependence of subsystems is the sociotechnical system has undergone much study at the Tavistock Institute in London (Rice; Trist and Bamforth, 1951). The technological changes in the United Kingdom have been studied since the ,have long been a traditional, somewhat conservative, industrialized society. Productivity and technology were analyzed but the

results often mentioned social, worker related, factors that were originally not considered. Role analysis, definition of job function, and other matters became concerns that affected the other subsystems within these organizations. Changes in the flow process were needed to affect progress. The structural design of the company remained intact but climate was changed to create higher productivity.

Lewin (1951) proposed the concept of "force-field analysis" to deal with change in an open system. This deals with the force of different vectors on an organization in the active process of maintaining equilibrium. Increasing one set of vectors without decreasing another will definitely affect the organization's equilibrium. Lewin suggests a three step process of: 1) unfreezing, 2) moving, and 3) refreezing. This process helps to illustrate the institutionalization of change that is necessary for progress to occur. The most effective approach is to minimize the resistance to change through this process of unfreezing.

Gellerman (1969) suggests the two approaches of cost control and value adding as strategies for organizational change. This may have similar elements to Likert's (1961) human-resource accounting concept. This helps to provide the view that organizational members are assets rather than expenses. This leads to the belief that Sokolik (1969) presents; that in the future, personnel departments may be replaced by two departments. These would consist of one area

dealing with pay and working conditions while the other area would deal with fostering change, adaptability, and growth. This would also foster and include the grouping of personnel activities according to the needs of the actual workers.

The reduction of forces against change is the key to progress, common to all theorists' views. Lippitt, Watson, and Westley (1958) have expanded Lewin's model into five steps which characterizes some commonalities in this area: 1) development of need for change (unfreezing), 2) establishment of a change relationship, 3) working toward change (moving), 4) generalization and stabilization of change (freezing), and 5) achieving a terminal relationship.

Lundberg (1963) suggests that systems form or exist in three levels: 1) the personal, 2) the interpersonal, and 3) the multigroup system (also containing nonhuman components). Lundberg uses a matrix to illustrate the interrelationships within and among these levels. This matrix is useful to help determine and predict role delineations and can help to indicate the propensity for single-cause thinking.

These perspectives, along with those of other theorists as well, form the basis for the development of a pattern of inputs, organizational transformations, and outputs. Bringing about change can be implemented through the modification of the structure of the flow processes. Several generalities apply throughout systems theorists' approaches: 1) all three perspectives need to be considered due to the interdependency

of subsystems, 2) the initial intervention is usually between the human and structural subsystems, 3) change is related to technology and organizations must be viewed as sociotechnical systems, 4) single-cause thinking must be reduced by using open systems approaches, 5) techniques for change must be appropriate to the organization, and 6) continued diagnosis is key to effective change. Climate must be a primary consideration when considering change and the unfreezing process must be carefully evaluated from a systems point of view prior to its institutionalization. The lack of consideration at this juncture could result in changes detrimental to the organization as a whole.

The field of system design can benefit greatly from the systems view and this will be reflective of the basic managerial philosophy. This philosophy may be either implicit or explicit, clear or vague. This serves as the framework and foundation for managerial behavior. There are three theories of management that can serve as a base for a philosophy: 1) traditional model, 2) human relations theory, and 3) human resources theory (Miles, 1975).

Traditional models would stress layers of management, extreme specialization, and formalized policies and procedures. The human relations theory suggests linkages between an organization and its environment and the maintenance of these in an open fashion. Decisions must take these linkages into account as well as the degree of openness and interaction with

the environment. Measures of organizational effectiveness must also be considered when designing an organization as these are the measures of long-term survival and growth. Effective environmental sensors are necessary to provide feedback for adaptability. This adaptability and change are important for organizational survival and optimal goal attainment. System interface networks must be established early in the process to effectively make use of resources. This network interaction should be predefined as directly relating to organizational goals. Critical systems and subsystems should be considered and included where necessary and those not having any influence on organizational mission should be identified as such and potentially excluded.

Environmental distinctions may be necessary to define prior to system design. Micro, intermediate, and macro environments must be considered. The micro environment is within the organization itself and includes: 1) the goal and work system, 2) the structure, communication, power, and authority system, and 3) the human factors system (Hodge and Johnson, 1970). The goal and work system involves the primary mission, specific objectives, and the work directly related to the accomplishment of the mission. The power and authority system is concerned with the organizational decision-making ability of the system. These systems are linking systems that operate to insure organizational effectiveness and efficiency. The human factors system contains both informal and formal as well as

interpersonal relationships and behavior patterns. This is the system that deals with role perceptions, leadership, and motivation.

The intermediate environment links the organization to its macro environment. This area facilitates resource acquisition and the distribution of products and services to the environment. This may be accomplished by outside agencies and consultants as well as some internal positions, such as company recruiters, corporate lawyers, and firm's advertising departments.

The macro environment can be broken into seven major systems: 1) cultural, 2) political, 3) economic, 4) competition, 5) technology, 6) human resources skill/ education mix, and 7) customer/client groups. Within each of these systems are subgroups that must interact with an organization. Most of these systems are self-explanatory but an interesting concept that is not always considered is the human resources component with education/skill mix that relates directly to the environmental pool of employees that are available for the particular organization. These systems interact either directly or indirectly with an organization. Some organizations incorporate parts of the intermediate environment directly within organizational bounds. It may have its own bankers, suppliers, dealers, legal staff, etc. Therefore they develop their own linkages and life-lines to the macro environment.

Organizations that develop a closed-system philosophy eventually cease to exist by shutting out and adapting to their environment. These organizations do not bring in any new resources and become ineffective at providing goods and services to the environment, no longer satisfying societal needs. The creation of too great a buffering or blocking system can create this lack of flexibility and response to environmental demands.

The discipline of systems analysis is also necessary to include when attempting to understand the systems approach. Six main approaches are prevalent in systems analysis: 1) the mechanistic/bureaucratic model, 2) human relations model, 3) individual behavior model, 4) the technological model, 5) the economic model, and 6) the power model. The mechanistic model has its basis in the stimulus-response theory of behavioral psychology and views people in the organization as programmable and predictable.

The human relations model was developed from the Hawthorne studies and work by Lewin. Interpersonal actions explain people's behaviors and little consideration is placed on formal organization. The individual behavior model reflects the thinking of Maslow and Herzberg looking at perception and motivation and the satisfaction of needs. The technological model emphasizes the way an organization internalizes parts of the macro environment. The economic model relies on the implied fact that all decisions are economic decisions and

rationality is the major contributing force. Power is viewed as the ability of an organization to exert influence over its members and its environment. The operation of an organization is therefore considered to be a series of power struggles using this point of view.

A general systems approach can be used to help organize the concepts of organization. The environment is the basis for all organizational action. Organizations satisfy environmental needs. The organization's work system then organizes and follows through on the objectives that the environment helps to establish. The organization is structured to facilitate this work system. Design considerations involving power and authority relationships, differentiation, and delegation of decision-making are necessary. A renewal and change process are final components of this system to facilitate survival and optimal organizational effectiveness.

Hodge and Anthony (1988) suggest an integrated model using the concepts of input-transformation-output combined with the ideas of micro-intermediate-macro environments. These concepts, following the application of general systems theory, help to integrate approaches in analyzing organizations in terms of their ability to meet challenges, change, and continually renew themselves.

Despite differences in wording, theorists have some commonality in the definition of a system. References to elements, parts, objects, etc. tend to be common. The use of

the terms interdependent, interrelated, and relationships are also shared. Several authors have suggested classification systems to help further clarify the concept of systems. Although these differ, they represent a common purpose of creating a tool for examining and analyzing an organization within the systems approach. This helps to provide a vehicle to integrate the knowledge from diverse, highly specialized fields such as Bertalanffy (1952) first suggested by his "parallelism" concept.

Bertalanffy's parallelism created a frame of reference for analysis. This provided for the breaking down of an existing whole into its elements or parts so the relationships to the whole could be better depicted. Barnard (1938) and Simon (1945) suggested that a conceptual theme is needed to better study administrative theory. Argyris (1962) formulated three essential activities of an organization: 1) achievement of objectives, 2) internal maintenance, and 3) adaptation to the external environment. Organizational growth was then theorized as a function of the extent to which these activities were carried out.

Closed systems have boundaries that are impermeable; no exchange with the external environment. Open systems have relatively permeable boundaries, receiving inputs and exchanging energies with the environment. Scholars discuss the degree to which systems are open since this permeability may exist in varying amounts and various times. Social systems are

especially unique in this arena, boundaries may be in a constant state of flux and difficult to describe globally. Definition must occur within context and function, at a given point in time. It is suggested that the major function of organizational management may be to help provide integration and cooperation among differing groups through these permeable boundaries.

Systems theorists share the thinking that complex organizations are hierarchical. This is indicative of a group of subsystems within a system, within a broader suprasystem. This leveling is integrated, especially within the context of social systems. This view stresses integration and holism.

Organizations are systems that are capable, if open, of effectively combatting entropy. A tendency toward a dynamic equilibrium is a constant goal. Shifting objectives, reallocating resources, or restructuring in response to changes helps an organization to adapt and survive; maintaining a balance. Maintenance devices help to see that an organization does not respond so rapidly that several of its subsystems get out of balance. Both maintenance and adaptive structures are necessary to help an organization achieve and maintain this balance.

Feedback is one element of organizational control. This was first proposed by Weiner in the study of cybernetics and directly refers to the response to output. It is a return communication or reaction to information processing behavior.

Feedback can be either positive or negative, internal or external, and affect the organization's equilibrium in many ways; either providing support or suggesting change. In closed systems there is a direct cause-and-effect connection between input and output. However, open systems display equifinality. This helps to differentiate the results from similar inputs when necessary.

Three basic concepts surround the application of theory: 1) initial inputs do not determine to which extent the goals will be realized, 2) organizational outputs may vary even though inputs are similar, and 3) there is no best way to achieve an organizational goal (contingency theory). This contingency allows for alternative approaches and methods to achieve desired results, thus allowing for the possibility of the state of equilibrium to best occur. Immegart and Pilecki (1973) best suggested this with their theories on equifinality.

IMPLICATIONS FOR EDUCATIONAL ADMINISTRATION:

There are many methods of applying systems theory to the study of educational administration. Four main applications are suggested by Kimbrough and Nunnery (1988): 1) educational administration is a social process within a social system, 2) schools are viewed as social systems, 3) systems propositions can be used to guide educational research, and 4) systems theory can be used by the day-to-day practitioner. Getzels and

Guba (1958) were among the first to use systems theory in educational administration. Nomothetic and ideographic dimensions of role analysis were the basic dimensions of their application, further analyzing and/or defining the roles of the educational administrator. These was identified retrospectively through observed behavior patterns and some predictability was suggested through this patterning. This may seem overly simplistic but dimensions of cultural and biological influence were later added. This theory provided heuristic value toward the connection between systems theory and educational administration. The connection between the external forces and the administrator became the focus of study as a result. Clarification of expectancies became a prime importance through this connection.

Three main sources of conflict appear to arise: 1) intrarole conflict, 2) intrapersonality conflict, and 3) role-personality conflict. As a result of these delineations, three leadership-followership styles also emerge: 1) normative (nomothetic), 2) personal (ideographic), and 3) transactional. These classifications can be used to categorize administrative behavior and evaluate the effectiveness of different styles in different situations.

Parsons (1951) suggested that educational systems could be characterized into the three arenas of technical, managerial, and institutional subsystems. Teachers, support personnel, administration, and the community; and their appropriate

functions can be defined within these parameters. Schools must be open enough to adapt within these frameworks but yet not too open as to encourage chaos. System energy must be balanced so that some degree is spent on maintenance and some on adaptive action.

Miller (1966) presented 173 systems propositions that have application to educational administration. Although some of his hypotheses have been supported, some may have been erroneous, and further research is needed to yet determine the value of others. This research is, however, of value in that it helps to provide a heuristic as well as using some of Miller's specific hypotheses to develop administrative tactics and potential researchable methodology. Such a hypothesis is: "Segregation increases conflict among subsystems or components of a system, and a higher proportion of adjustment processes must be therefore devoted to resolving such conflicts, which means they cannot be devoted to advancing goals of the system as a whole." This idea alone helps to shape the thinking that systems theory is useful as a framework for educational research.

Thinking in a systems mode is an effective method for day-to-day, practical, administrative decision-making. The recognition of the dynamic relationships among subsystems and groups is critical toward affecting progressive change. This does not mean that there is a stock solution for a given problem but rather implies a way of thinking geared more toward

the conceptuality of the organization and that particular situation in its holistic dimension. This offers a broad strategy for analyzing systems, correcting its faults, and improving its cost effectiveness. Relationships between parts are stressed; both internal and external. This thought process can be used to guide observation, make predictions, and formulate actions for a goal oriented, practicing administrator.

This systems theory does not form a set of empirical assumptions from which laws can be developed. Some have suggested that this is not even theory but a methodology that is empirical and interdisciplinary. It is a direction in the contemporary philosophy of science aimed at the integration of diverse content areas by means of a unified conceptualization. Many of the concerns of abstractness, oversimplification, rationality, tightness, etc. have merely led to a more and greater research emphasis in this field.

Weick (1985) suggests six themes as the focus in recent research in organizations: 1) rationality is less prevalent, 2) organizations are more segmented than monolithic, 3) organizational segments are small and stable, 4) connections among segments are variable, 5) organizations have a high degree of ambiguity and 6) the basic task of management is to reduce ambiguity to tolerable levels. These newer ideas do not represent a rejection of systems theory but emphasize the thinking that organizations are, themselves, imperfect systems.

The systems movement is not an attempt to develop some "super science" but a method or approach to dealing with problems or situations based on the thinking that all things derive their characteristics from the general properties of systems. A system can be defined as a set of objects together with relationships between those objects and their attributes (Miller, 1965). Systems have a uniqueness of character that distinguishes them from other systems, including the ability to be open or closed. This does not imply that it will always remain in such a state. This also does not imply functioning maximally, dynamic, or contributing in nature.

The main goal is progress from an embryonic state to a state of maturity characterized by increasing order, differentiation, variation, and complexity. This is reached through allocation of resources and communication within itself and with the environment. Systems are complex entities with both qualitative and quantitative dimensions. One must know the specific components and how these components are interrelated and interdependent. Obviously, a new administrator must get to know the school district, the school, the faculty, the materials, the staff, and the pupils to begin to understand the school as a system. Another implication is that all systems tend toward entropy, or death. In the school situation, the administrator must understand the subsystems and create maximization of their effects so that the school may continue to truly fulfill its function. Self-awareness and

personal growth must be key elements of an administrator's self concept. These tend t suggest that the administrator is an open system his/herself leading to the combatting of entropy and maximizing their own performance.

There are many universal system properties that have implications for educational administration (Hearn, 1958). There is a tendency toward entropy, dynamic existence is not automatic but must be actively maintained. All systems exist in some time-space dimension which is irreversible. Boundaries also exist for all systems and functioning within those boundaries is often easier than changing the boundaries themselves. All systems have environments, some are proximal and some distal. All systems have variables and parameters which may affect the structure and functioning of the system itself. Another property is that all systems have subsystems and, in fact, most subsystems have additional subsystems. The boundaries of these subsystems may be more arbitrary than those of the system itself, therefore making the organization more complex. The last characteristic is that all systems, except the very large and some closed systems, have suprasystems that they are contained within. For example, a school district is contained within a municipality which gets its funding from the state, etc. Also the school as a subsystem of the community is only one such subsystem, others may be the police department, the sanitation department, the

parks system, etc. all of which are interactive subsystems of the larger suprasystem of the community.

In addition, there are several properties that are unique to open systems. Schools and social systems in general are categorized as, more or less, open systems. Open systems maintain themselves by exchanging energy with their environment (they have inputs and outputs). Open systems tend to regulate themselves toward a steady state. These systems tend to control their own destiny to some degree by integrating components and properties to achieve some balance. Self-regulation is also a characteristic of open systems. Schools, like other systems, have such controls as budget votes, board elections, negotiation procedures, review committees, and administration. Open systems have the ability to provide alternative procedures to achieve a goal, called equifinality. System maintenance is accomplished through dynamic interaction of functional subsystems, without this capability entropy will increase. Some of this maintenance takes place through the interpretation of feedback. Open systems use this feedback to monitor procedures and fight entropy. Open systems characteristically display progressive segregation. This is the process of division of the functional subsystems into a hierarchy. Schools provide an excellent example of this characteristic. Schools tend to organize in a manner which is most efficient to accomplish a given system task. The establishment of appropriate rules and procedures is

an example of progressive mechanization which is another characteristic of an open system. This allows for maximal control for adaptation within the system's environment. The last characteristic is one which only open systems possess, that is negentropy. This is the tendency to fight entropy and maximize its existence. Few systems have infinite lives but this ability means that a system can control some of the forces that control its duration and quality of existence.

There appear to be five major theoretical approaches to the concept of systems (Immegart and Pilecki, 1973). There are comprehensive systems theories which focus on the whole and the appropriate components. There are subsystem or process theories that deal with microscopic analysis on the processing of inputs through the system into outputs. Feedback theories or system control theories basically developed from cybernetics and are concerned with the control dynamics of systems. There are also theories of system properties which help to formulate long-term, evolutionary system analysis. Output theories and output analysis are largely based on the operations research movement and are mainly concerned with the results of system activity.

The value of these different theoretical perspectives can be best illustrated not in their singular use but by the use of multiperspective approach to the analysis of a system within and of itself. The greatest value of systems theory is the potential for the evaluation of any system.

Young (1964) identified four general categories of system concepts: 1) systemic and descriptive factors, 2) regulation and maintenance, 3) dynamics and change, and 4) decline and breakdown. Systemic and descriptive categories consist of concepts which help to discriminate between systems, organize and analyze large quantities of data, and conceptualize the fundamental nature of various types of systems.

Regulation and maintenance concepts deal with the maintenance of that equilibrium state and the dynamic balance between the components and properties that is necessary to fulfill that end. School systems maintain through a system of external and internal methods. Community votes on budgets, criticism of the instructional program, demands from powerful constituent groups, teachers' demands, educational technology, student requests for relevant programs, etc. are all elements that help to serve as regulatory devices. A homeostatic relationship within the system subsystems helps to provide a balance. This is best achieved through information and communication processes.

One of the central concerns here is that of feedback. This feeds the homeostatic process and provides for a valuing of the viability and contribution of the system as a whole. Feedback is a special case of information communication and is not random or disorderly, especially important to effective school functioning. Feedback is purposeful and evaluative about the system itself, if so, it will contribute to the

system's potential. This is usually judgmental information that is intended to adjust future action and behavior through a review of the past performances in terms of the system's functionality or its goals and objectives. A truly open system must effectively deal with this and have mechanisms in place for receiving, handling, and using such evaluative information that will ultimately be beneficial to the system. Feedback is both informal and formal as well as positive or negative. Schools tend to receive more negative feedback than positive (Rusche, 1968). It may take the shape of continuous feedback, intermittent feedback, proportional feedback (quantity of feedback is proportional to system needs), or relay feedback (solicited). Proportional feedback is usually the most valuable. Relay feedback is helpful but may miss true potentials. Both positive ad negative feedback are necessary to both support the system and also to affect change. Balancing these as well as avoiding evaluative information overload may be key to successful system regulation and maintenance. Obviously to be of value the feedback must conform to criteria of functionality and relevance. When feedback is needed a conscious mechanism must be implemented to effectively deal with this vital information.

Only open systems can develop, adapt, and evolve. System growth must be conditioned by internal system forces as well as external environmental forces. An open system is not in full control of its destiny but it can make some choices. According

to Miller (1955) system growth is directly attributable to the availability of input energy. This input energy is only actively sought in an open system. The four major determinants of system change are feedback, memory-learning, change-capacity, and system-environmental relations (Marney and Smith, 1964). Evaluative information through these determinants is key to the system change process. A system's memory and learning processes must be refined and developed in order to be capable enough to accept and react to change, as well as the capability to extract the needed resources from its environment. System energy and resources need to be committed and directed solely for the purpose of effecting change.

All systems have the ultimate choice to change or not; to grow or to degenerate. System change is always costly and attention must be given to the appropriate determinants of this specific system change. Many of the components that can contribute to change may also threaten the actual existence of a system. Unless these are controlled they will contribute to decline, breakdown, and eventual entropy.

Often times it is necessary to put off the steady state, balance and seek survival and maintenance until a healthier organizational status is secured. System stress is an indicator of potential for system decline. This must be carefully monitored and recognized as such. This is a generic system state that effects the very existence of a system (Selye, 1957). Miller's work defines stress more in terms of

organizational survival and indicates that the most successful systems appear to use least costly defense methods first and proceed only as high as necessary. Overcompensation can result in collapse of the system and a careful balance is necessary when responding to stress. Stress can be both motivator (Brown, 1967) and perhaps not (Lasell, 1969). The total sum of stress on an organization is the immediate and long-term threat to the system's existence.

Implications are numerous but five major ideas come to focus (Immegart and Pilecki, 1973): 1) the administrator must be aware of the signs of decline, 2) attention must be given to the cost of system disruptions, 3) the least costly (in terms of system resources) method should be employed first, 4) stress is different from person to person, be aware of its variability, and 5) if a system must spend all of its energy on survival and maintenance little will be left for progress and growth. The purposive system activity as illustrated by the concepts of an open system are the most relevant and appropriate to the practicing school administrator. One must possess skills in identifying these elements and effectively dealing with them in a systems approach for maximum benefit. Systems theory can provide an adequate and effective framework for attempting solutions to the complex problems that often result from the day-to-day process of educational administration.

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Appendix 16

END

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